Detection of temporary surface water bodies in Niger using high resolution imagery

DETECTION OF TEMPORARY SURFACE WATER BODIES IN NIGER USING HIGH RESOLUTION IMAGERY

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Photography encouraged

1. OBJECTIVE

Identify a methodology to semi-automatically localize **temporary surface water bodies (TSWB)** based on UAV photogrammetry technique and DTM analysis. It aims to identify the maximum potential extension of stagnant water pools in urban areas, regardless the moisture of the soil nor the season.

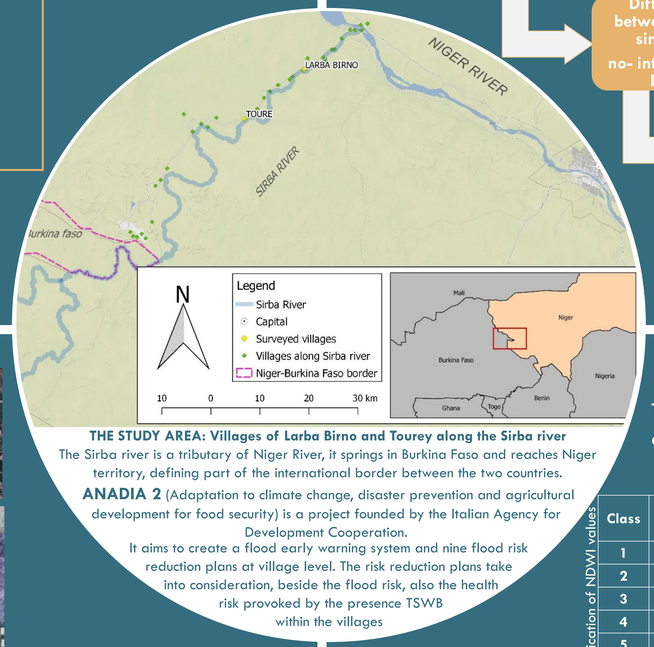
Negative effects of TEMPORARY SURFACE WATER BODIES in urban areas:

- development of insects, including the ones vectors of diseases;
- Where TSWB are close to latrine sanitation facilities, residuals can rise up and create an insane living environment;
- hindering the practicability of the roads networks.

WHAT INFLUENCES THE TSWB

- TOPOGRAPHY
- RUN-OFF
- PRECIPITATIONS

In urban areas TSWB issue can be managed through well-designed drainage systems or channels networks. Addressing TSWB problem within villages and cities requires not only the localization of the water bodies, but also of their **seasonal maximum extensions.**



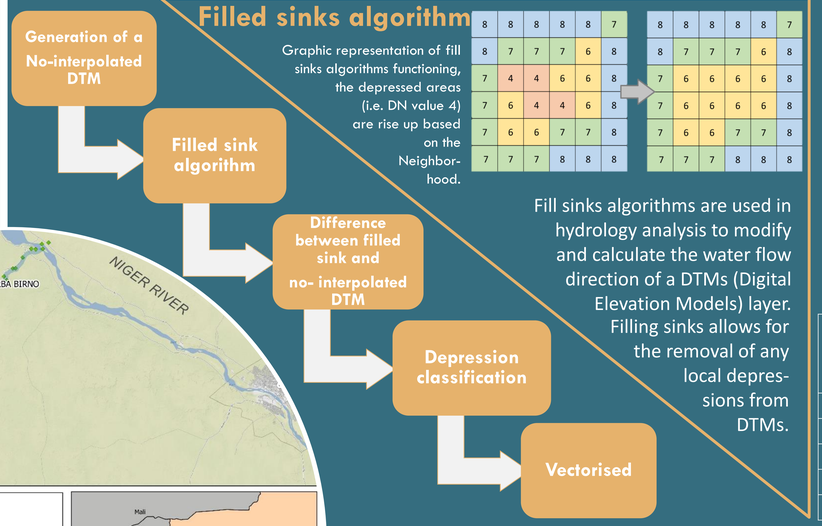
THE STUDY AREA: Villages of Larba Birno and Tourey along the Sirba river

The Sirba river is a tributary of Niger River, it springs in Burkina Faso and reaches Niger territory, defining part of the international border between the two countries.

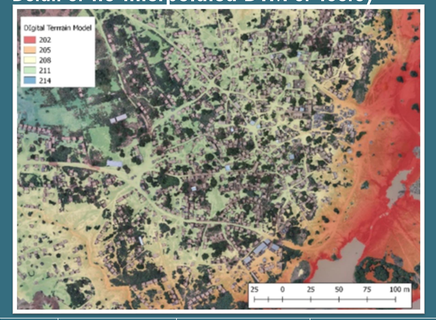
ANADIA 2 (Adaptation to climate change, disaster prevention and agricultural development for food security) is a project founded by the Italian Agency for Development Cooperation.

It aims to create a flood early warning system and nine flood risk reduction plans at village level. The risk reduction plans take into consideration, beside the flood risk, also the health risk provoked by the presence TSWB within the villages

3. METHODOLOGY TO DETECT POTENTIAL TSWB



Detail of no-interpolated DTM of Tourey



Class	Depth interval (m)	Percentage of cover in Tourey (%)	Percentage of cover in Larba (%)
1	0.005 – 0.02	2.06	27.23
2	0.02 – 0.03	80.75	34.57
3	0.03 – 0.04	11.35	17.14
4	0.04 – 0.05	2.50	9.18
5	>0.05	3.34	11.88

2. DATA COLLECTION

WHO?

The flights were realized by the local enterprise Drone Africa Service (DAS). DAS uses self-made UAV system.

HOW?

The flights were planned and automatically controlled by the *ArduPilot* software.

WHICH SENSORS?

Sony ILCE-5100 camera and an experimental sensor created by the Politecnico di Torino with a Raspberry Pi computer and two Raspberry Pi 2 cameras.

X 20

In each village a campaign of measure using two GNSS dual frequency receivers, STONEX S10 models, in RTK rover-base modality was performed for georeferencing the data. In each village, 20 reference points have been realized. These points have been used as markers in the photogrammetric solution.

Characteristics	Sony ILCE	Raspberry
Resolution	24.3 MP	5MP
Bands sensor	RGB	RGBNoIR
ISO settings	1/125	1/100
Shutter frequency	Automatic-ally set	1 Hz
Lateral overlap	70%	70%
Longitudinal overlap	60%	60%
No.of flight to cover each village	1	2
Average duration of flight	30 minutes	30 minutes
Height of flight from the ground	270 m	120 m
GSD	2.5 cm/pixel	6 cm/pixel

WHAT WE HAVE PRODUCED?

1 **RGBN orthophoto** derived from the Raspberry device with a resolution of **6cm, 6cm precision**

1 **RGB orthophoto** derived from the SONY camera with a resolution of **4 cm 8cm precision**

DTM raster derived from the SONY camera with a resolution of **4 cm**

DSM raster derived from the SONY camera with a resolution of **4 cm**

4. DATA VALIDATION

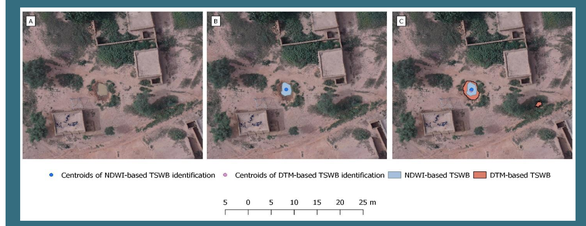
The orthophoto obtained from the elaboration of the Raspberry Pi acquisitions, was used to calculate a radiometric index: Normalized Difference Water Index (**NDWI**) by McFeeters (1996).

NDWI = (Green-NIR) / (Green+NIR)

Classification of NDWI values

Class	NDWI interval	Cover in Tourey (%)	Cover in Larba (%)
1	-1 – -0.112	1.66	4.35
2	-0.112 – -0.069	8.06	20.59
3	-0.069 – -0.026	28.15	35.68
4	-0.026 – 0.005	41.09	31.68
5	0.005 – 0.025	11.17	6.25
6	0.025 – 0.030	7.16	0.45
7	0.030 – 1	2.70	0.89

Raster of DTM-TSWB and NDWI-TSWB were re-classified in 0 and 1 values: value 0 was assigned to the pixels that do not described TSWB, while value 1 was assigned to TSWB pixel.



DTM-TSWB – NDWI-TSWB =

- **0** **Total correspondence** between the DTM and NDWI data.
- **+1** Present in DTM not in NDWI analysis. It detects **the potential extension of TSWB** even if there is no water stagnation at survey time.
- **-1** Present in NDWI not in DTM analysis. Possible **imprecision** derived from SfM software, or **TSWB complete filled with water**. For this pixel a further visual validation against the Sony RGB data was realized.

Acknowledgement

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